CLAIMS

1. A machining spindle comprising an inner shaft arranged for carrying a first tool for machining a workpiece and an outer shaft arranged for carrying a second tool for machining the workpiece, the shafts being mounted for rotation about a common axis and for axial movement relative to each other, and the machining spindle further comprising a main body within which the shafts are journalled, the inner shaft being mounted within the outer shaft which in turn is journalled by means of an air bearing within the main body and there being an air bearing provided to allow relative axial movement between the inner and outer shafts.

2. A machining spindle according to claim 1 in which the main body comprises jets to provide air to the air bearing allowing relative rotation between the main body and the outer shaft.

3. A machining spindle according to claim 1 or claim 2 in which the inner shaft comprises jets to provide air to the air bearing allowing relative axial movement between the inner and outer shafts.

4. A machining spindle according to any preceding claim in which the

inner shaft is journalled within the outer shaft to allow relative rotation between the two shafts.

5. A machining spindle according to claim 4 in which the bearing for allowing relative axial movement between the inner and outer shafts is also arranged to allow relative rotation between the inner and outer shafts.

6. A machining spindle according to any preceding claims in which the air bearings are arranged such that air is purged from the spindle at positive pressure, relative to the ambient pressure, at all locations which may be exposed to the by-products of machining operations.

7. A machining spindle according to any preceding claim in which supplementary sealing means are provided.

8. A machining spindle according to any preceding claim in which the spindle comprises at least one electric motor for rotatingly driving the shafts.

9. A machining spindle according to any preceding claim in which the spindle is arranged to allow the first shaft to rotate at a different speed from and/or in an opposite direction from the second shaft.

10. A machining spindle according to claim 9 in which the spindle comprises two electric motors, a respective one of the motors for rotatingly driving each shaft.

11. A machining spindle according to any one of claims 1 to 8 in which the spindle is arranged so that the first and second shafts rotate in synchrony with one another.

12. A machining spindle according to claim 11 in which drive transfer means are provided for transferring drive from one shaft to the other.

13. A machining spindle according to claim 12 in which the drive transfer means is insulated so that it does not offer an electrical conduction path between the two shafts.

14. A machining spindle according to claim 12 or claim 13 in which the drive transfer means comprises a pin mounted on one of the shafts and disposed in a recess or an aperture in the other of the shafts such that shafts may move axially relative to one another without interrupting the transfer of drive.

15. A machining spindle according to claim 14 in which the pin is radially mounted.

16. A machining spindle according to claim 15 in which the pin is of insulating material or coated with insulating material.

17. A machining spindle according to any preceding claim in which the spindle comprises axial drive means for axially driving the shafts relative to one another.

18. A machining spindle according to any preceding claim in which encoding scale means are provided to indicate the axial position of at least one of the shafts, which shaft being movable axially relative to the main body.

19. A machining spindle according to any preceding claim comprising sensor means for sensing when at least one of the tools carried by a respective one of the two shafts contacts with a conducting or semi-conducting workpiece, the sensor means being arranged to sense a current flowing around a path including the workpiece and at least one of the shafts.

20. A machining spindle according to claim 19 in which the sensor means

comprises at least one brush contacting with one of the two shafts.

21. A machining spindle according to any preceding claim in which the inner shaft is supported by insulating guide bearings.

22. A machining spindle according to any preceding claim, said spindle being a dicing spindle for use in dicing semi-conductor wafers, and the shafts each being arranged for supporting a respective cutting wheel.

23. A machining spindle according to any one of claims 1 to 21, said spindle being a grinding spindle arranged for supporting grinding tools, for example cup grinders for grinding a surface by axially moving the tool into contact with the workpiece or radial grinders arranged for use in form grinding a complex shape.

24. A machining apparatus comprising a machining spindle according to any preceding claim and a support arrangement for supporting the spindle.

25. A machining apparatus according to claim 24 and further comprising a workpiece table arranged for supporting a workpiece during machining.

26. A method of machining a workpiece comprising the step of using a machining spindle as claimed in any one of claims 1 to 23 or machining apparatus as claimed in claim 24 or 25.

27. A method according to claim 26 comprising the step of using the ability to move one shaft axially relative to the other to compensate for thermal growth, or more particularly differences of thermal growth, in the shafts or other components as they heat up due to operation.

28. A method of dicing semi-conductor wafers using a machining apparatus comprising a workpiece table for supporting a wafer and a machining spindle comprising a first shaft carrying a first cutting wheel for machining the wafer, and a second shaft carrying a second cutting wheel for machining the wafer, wherein the shafts are mounted for rotation about a common axis and for axial movement relative to each other, and the method comprising the steps of:

cutting along streets in one direction on the wafer, having a first street spacing, using the two cutting wheels set at a first wheel spacing;

moving the shafts supporting the two cutting wheels axially relative to one another to set the cutting wheels at a second wheel spacing; and

cutting along streets in another direction on the wafer, having a second street spacing, using the two cutting wheels set at the second wheel spacing.